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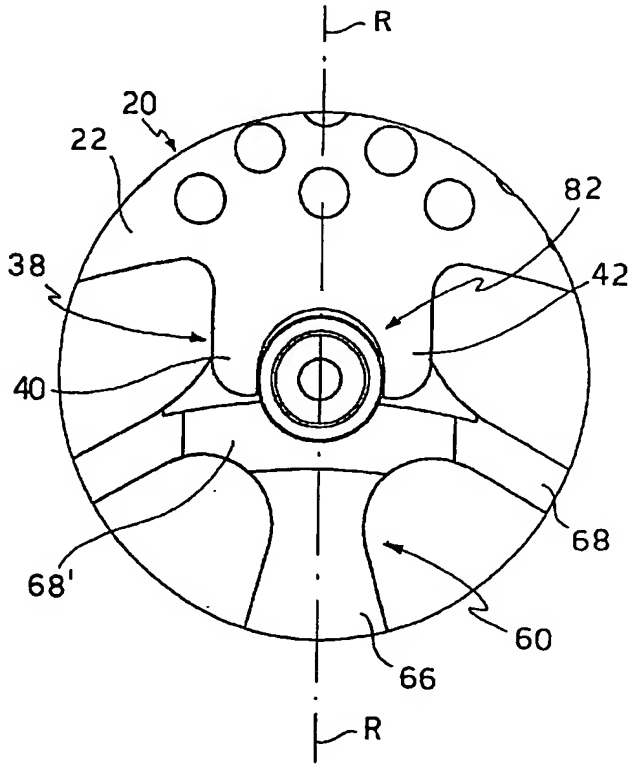
(54) Title: DISK FOR A DISK BRAKE



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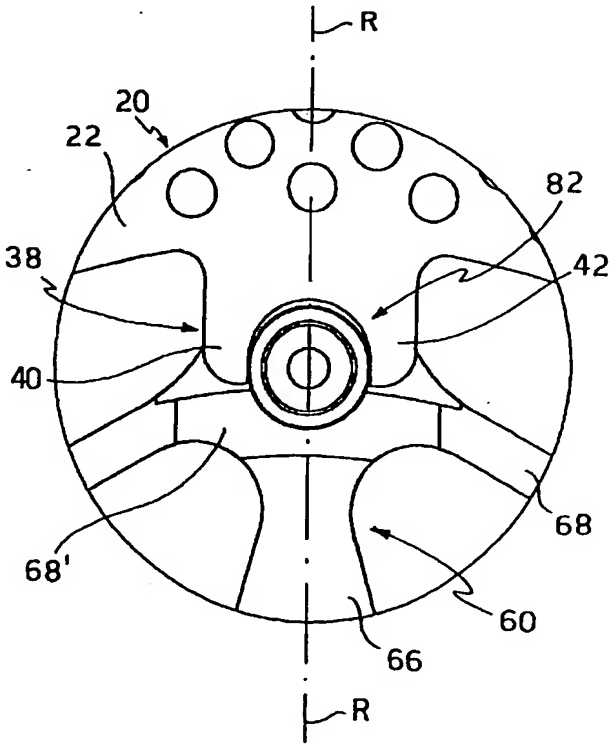

(57) Abstract: A connection system between a bell (60) and a braking band (20) of a disk-brake disk is described. The bell (60) has eyes (70) with through-holes and the band (20) comprises radial protuberances (38) provided with housing seats (44). In the assembled configuration of the band (20) and of the bell (60), protuberances are arranged astride respective eyes (70) with the through-hole and the seat of each protuberance aligned. The bell is connected to the band (20) by means of a bush (82) suitable for being inserted in th though-hole of the eye and at the same time engaging the braking band, by extending through the seats. Moreover, the seats are shaped in a manner such as to have straight portions in their sides and are suitable for permitting of the braking band (20) on the bush (92).

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DESCRIPTION

"Disk for a disk brake"

The present invention relates to a connection system between the braking band and the bell of a disk-brake disk, particularly for use on motorcycles.

It is known to form the connection between the braking band and the bell of a disk-brake disk by the engagement of a peripheral portion of the bell by spacer elements disposed on the inside of the braking band, by means of the engagement of peripheral seats formed in the bell by the spacer elements of the band. The peripheral seats of the bell are open radially to allow the band to slide in conditions of expansion due to overheating.

Clearly, the above-mentioned connection system has the disadvantage that the bell has poor structural reliability, particularly in the peripheral region in which the seats are formed. In fact it is clear that this region is particularly subject to mechanical stress concentrations which may lead to structural discontinuity states, to the formation of cracks and, finally, to breakage.

An example of a connection system of the type indicated above is described in United States patent No. 4,448,291.

It is also known to form the connection between the

braking band and the bell by connecting a concentric annular and inner portion of the braking band to a fork-shaped portion of the bell by means of a bush. A radial clearance between the bush and the holes in the braking band in which the bush is engaged allows the braking band to slide in conditions of expansion due to overheating.

A connection system such as that described, however, is not suitable for connecting a bell to a braking band when the band and the bell are quite thin, as in the motorcycle field.

An example of a connection system of the type indicated above is described in United States patent No. 5,810,123, in the name of " Freni Brembo S.p.A.".

There is therefore a need to provide a system for connecting a braking band to a bell which is effective and reliable even with quite small thicknesses of the band and the bell, whilst allowing the braking band to slide as a result of thermal expansion.

The problem underlying the present invention is to devise a disk-brake disk which has a connection system between the band and the bell that has structural and functional characteristics such as to satisfy the above-mentioned needs and at the same time to overcome the problems mentioned with reference to the prior art.

This problem is solved by a disk-brake disk

according to Claim 1.

Further characteristics and the advantages of the disk according to the present invention will become clear from the following description of a preferred and non-limiting embodiment thereof, in which:

Figure 1 is a side view of a disk-brake disk comprising a braking band associated with a bell,

Figure 2 shows the disk of Figure 1 in a section taken on the line A-A of Figure 1,

Figure 3 is a side view of the braking band of the disk of Figure 1,

Figure 4 shows the braking band of Figure 3 in a section taken on the line B-B,

Figure 5 is a side view of the bell of the disk of Figure 1,

Figure 6 shows the bell of Figure 5 in a section taken on the line C-C,

Figure 7 shows a detail of a protuberance of the braking band of Figure 3,

Figure 8 shows a detail of the connection system between the bell and the braking band of Figure 1,

Figure 9 shows a detail of the connection system of Figure 8 in a section taken on the line R-R,

Figure 10 shows the connection system between the band and the bell of the disk of Figure 1 in a section

taken on the line R-R,

Figure 11 is an axonometric view of a bell according to a further embodiment,

Figures 12a to 12f show the six orthogonal views of the bell of Figure 11.

With reference to the appended drawings, a disk-brake disk intended principally for use in motorcycles is indicated 1. In particular, the disk 1 is of the self-ventilating type.

The disk 1, which extends in an axially symmetrical manner about a central axis X-X, comprises a braking band 20 which extends about a braking axis Y-Y and a bell 60 which extends about a mounting axis Z-Z. The braking band 20 and the bell 60 are structurally separate and can be connected in a manner such that the mounting axis Z-Z of the bell coincides with the braking axis Y-Y of the band 20, defining the central axis X-X of the disk.

The braking band can be connected to the bell 60 by connection means 80 (described further below) for fixing the braking band firmly and releasably to the supporting bell. Moreover, in a mounted configuration of the disk brake, the bell 60 is intended to be connected, to a wheel hub (not shown) by suitable fixing means which can fix the bell firmly and releasably to the hub.

The braking band 20 comprises at least two plates 22

and 24 each defined by a braking surface or outer surface 22'' or 24'', respectively, and by an inner surface 22' or 24', opposite the respective outer surface.

The two plates 22 and 24 are preferably substantially identical and only one of them will therefore be described below.

The plate 22 comprises a ring 26 and a connecting portion 28 disposed inside the ring 26 and concentric therewith.

The ring 26 of the braking band 20 is substantially a flat plate preferably having a plurality of recesses 30, preferably of circular shape, on the side of the band having the outer surface 22''.

The circular shape of the recesses 30 is not intended to be limiting and, in different embodiments of the braking band, oval or wing-shaped recesses, or the like may be formed.

The recesses are disposed on the side of the plate 22 having the outer surface 22'', preferably along circular lines L having their centres on the braking axis Y-Y of the braking band, and preferably in a manner such that a uniform angular spacing P is maintained between recesses 30 disposed on the same circular line L.

There is preferably the same number of recesses 30 on each circular line L.

In a preferred embodiment, the series of recesses 30 on one circular line is offset relative to the series of recesses on the adjacent circular line. The angular offset of the recesses between two adjacent circular lines is preferably equal to half of the angular spacing p.

The plate 22 also has a plurality of projecting spacer elements 32, preferably of cylindrical shape, on the side having the inner surface.

In particular, for each recess 30 of the ring 26 disposed on the side having the outer surface 22'', there is a corresponding spacer element 32 of the ring 26 on the side having the inner surface 22'.

In the assembled configuration of the braking band, the spacer elements 32 of the two plates 22 and 24 face one another and are fixed together, preferably by a welding process.

In the assembled configuration of the band 20, the connected spacer elements 32 thus fix the two plates 22 and 24 firmly together and at the same time form a space 34 between the plates. This space takes the form of a plurality of ventilation ducts 36 which extend between the spacer elements 32.

The connecting portion 28 of the plate 22 of the braking band 20 comprises a plurality of protuberances 38

projecting from the portion of the ring 26 facing the braking axis Y-Y.

In a preferred embodiment, these protuberances 38 are formed integrally with the ring 26 of the braking band 20. Moreover, the protuberances are in the same plane as the ring 26 and are preferably spaced apart at regular intervals Q. In the embodiment described, there are six protuberances.

The protuberances 38 extend substantially radially and preferably have a "forked" shape in an end portion nearest the braking axis Y-Y of the band 20 so that each protuberance 38 opens out towards the braking axis with a pair of prongs 40 and 42.

The prongs 40 and 42 open out so that a housing seat 44 is defined at least partially between them by means of opposed sides 40' and 42'.

The opposed sides 40' and 42' of the prongs 40 and 42 are substantially symmetrical with respect to a radial axis R-R of the ring 26 which extends along the centreline of the protuberance 38.

Each of the sides 40' and 42' has a first, substantially curved portion, 40'' or 42'', respectively, preferably defined by a portion of a circle. In a preferred embodiment, the portions 40'' and 42'' of the sides 40' and 42' are defined by respective quarter

circles.

Moreover, each of the sides 40' and 42' has a second, substantially straight portion 40''' or 42''', respectively, which extends from the end of the respective curved portion 40'' or 42'' towards the centre of the ring 26, remaining substantially parallel to the radial central axis R-R of the protuberance 38.

The second portion 40''' or 42''' of each of the sides 40' and 42' of the prongs 40 and 42 defines a thrust surface for the connection system, for transmitting the torque generated on the braking band 20 during braking to the bell 60, each of the second portions 40''' and 42''' acting as a thrust surface according to the direction of movement.

The bell 60 which can be connected to the braking band 20 comprises at least one annular peripheral portion 62, a central ring 64, and a plurality of connecting spokes 66.

The annular peripheral portions are arranged concentrically about the connection axis Z-Z of the bell 60 and, in a preferred embodiment, take the form of a polygonal series of braces.

In one embodiment, the annular peripheral portion 62 takes the form of a series of six braces 68 connected in the region of respective end connection portions 68' of

the braces. The six braces 68 produce a hexagonal shape of the annular peripheral portion 62.

The number of annular peripheral portions of the bell 60 is not intended to be limiting and, naturally, embodiments which provide for two or more concentric portions are possible. Similarly, the shape of the braces 68, which is only preferably straight, is not limiting, and embodiments which provide for arcuate braces are possible. Moreover, the number of braces should not be considered limiting and embodiments with a number of braces greater than or less than six are possible.

In the region of the end connection portions 68' of the braces 68 of the bell 60, the bell has eyes 70 each of which has at least one through-hole 70' and which are formed in the end portions 68' of the braces 68.

The eyes 70 are preferably thinner than the braces 68 of the bell 60 so that they can be fitted between the protuberances 38 of the respective plates 22 and 24 of the braking band 20 that are disposed side by side and fixed together.

Preferably, the connecting spokes 66 extend radially from the connection portions 68' of the braces 68 of the bell 60 towards the centre of the bell and are connected to the central ring 64 of the bell.

In the embodiment described, there are six straight spokes extending towards the central ring 64 and their width increases from the eye 70 towards the central ring.

In the embodiment shown, the annular peripheral portion 62 and the central ring 64 are disposed in parallel planes which do not coincide so that they are connected by the spokes 66 to produce a frustoconical shape of the bell 60.

The connection between the bell 60 and the band 20 is achieved substantially by means of a bush 82 which can be fitted in the hole 70' of the eye 70 of the bell 60 and can engage both protuberances of the plates 22 and 24 when the plates are arranged side by side, so that the housing seats 44 of each protuberance 38 are aligned with the hole 70' of the eye 70 of the bell 60.

In other words, the bush 82 has a length such as to extend through the entire thickness constituted by the braking band 20 so as also to project relative to that thickness.

The bush 82 preferably terminates in a abutment head 84 and also has, at the end remote from the abutment head, an end protuberance 86 provided with a circumferential groove 88.

The end protuberance 86 can house a preloading spring 90, preferably formed by a Belleville washer or by

a crinkle washer, and an annular spacer element 92 such as a washer or ring. The circumferential groove 88 is suitable for housing a retaining ring 94.

The protuberances of each of the plates 22 and 24 of the braking band 20, the eyes 70 of the bell 60, and the bush 82 form the connection means 80 for connecting the bell 60 firmly and releasably to the braking band 20.

The bell 60 is preferably produced, in a first step, by machining of a flat plate from the solid and, in a second step, the holes are formed by a drilling operation.

In the assembled configuration, the braking band 20 has the two plates 22 and 24 disposed side by side and fixed firmly together so that the spacer elements 32 are superimposed, forming the ventilation ducts of the disk. Moreover, the plates 22 and 24 are positioned relative to one another in a manner such that the protuberances 38 of the plates are superimposed but spaced apart axially. The housing seats 44 of each protuberance 38 are consequently aligned axially.

The eyes 70 of the bell 60 are inserted in the space between the protuberances 38 so that the hole 70' of each eye is aligned with the housing seat 44 of each protuberance 38.

The bush 82 connects the braking band 20 to the bell

60, extending through the housing seat of the plate 22, the hole 70' of the bell 60, and the housing seat of the plate 24. In other words, the bush achieves a rotational restraint between the bell and the band, that is, during braking, a means for opposing rotation of the braking band 20 of the bell 60.

The end protuberance 86 of the bush 82 preferably projects at least partially relative to the thickness formed by the plates 22 and 24 so that the circumferential groove 88 is outside the braking band 20.

The preloading spring 90 and the spacer 92 are associated with the end protuberance 86. The retaining ring 94 locks the spacer 92 and the spring 90.

In particular, the positioning of the circumferential groove 88 on the end protuberance 86 is such that, when the spring 90 and the spacer 92 are fitted on the end protuberance 86 and the whole assembly is locked by the retaining ring 94, the spring 90 is in a preloaded condition. Moreover, this condition results in a thrust of the abutment head 84 of the bush 82 partly on the protuberance 38 of the plate 22 and partly on the end portions 68' of the braces 68 of the bell 60.

During braking, the braking torque generated on the braking band 20 is transmitted to the wheel hub by the connection system between the band and the bell 60 and

through the bell 60 itself.

The effect of the braking torque brings one of the prongs 40 or 42, alternatively, according to the direction of movement, into abutment with the outer surface of the bush 82.

In particular, the contact between one of the prongs and the bush 82 is due to the contact of one of the straight portions 40''' and 42''' of the prongs with the bush 82.

The braking torque is also transmitted to the bell 60 by virtue of the resulting contact between the bush and the surface of the hole 70' of the eye 70 of the bell.

Unusually, the system described for the connection of the braking band to the bell of a disk-brake disk achieves an effective and reliable connection, even with quite small thicknesses of the band and the bell, whilst allowing the braking band to slide as a result of thermal expansion.

The above-mentioned connection system also advantageously enables the braking torque to be transmitted from the braking band to the bell whilst minimizing the resultant force acting on the connection means between the band and the bell. In other words, according to an advantageous aspect, the above-mentioned

connection system enables a torque to be transmitted between the braking band and the bell, giving rise to a force on the connection means which is developed substantially along an axis perpendicular to the radial central axis of the protuberance.

According to a further advantageous aspect, the above-mentioned connection system enables the braking band to be positioned firmly relative to the bell whilst avoiding connection means which, whilst positioning the braking band relative to the bell, impede any expansion of the band due to braking.

In fact, the connection system advantageously makes use of resilient means for positioning the band relative to the bell, which do not prevent radial thermal expansion of the band.

Moreover, the connection system advantageously permits the mutual engagement of a band and a bell which are produced by simple and economical production methods.

According to a further advantageous aspect, the plates undergo uniform heating in the region of the braking band, and are thus particularly suitable for absorbing large thermal stresses due to heavy braking and subsequent cooling, reducing the damaging effects of stress concentrations due to the thermal stresses.

The plates also have the advantage of absorbing

large thermal shocks and of expanding or contracting whilst maintaining a high degree of symmetry, avoiding distortions in the structure, particularly in the braking surface of the band, which would otherwise result in vibrations and noisiness in general.

Finally, the above-mentioned plates have the further advantage of having connection portions that are suitable for transmitting large braking torques, preventing localized stress concentrations in the connection portion.

Naturally, in order to satisfy contingent and specific requirements, a person skilled in the art will be able to apply variations to the present invention.

By way of example, owing to its structural and functional characteristics, the braking band of the disk may be used separately, that is, it may be engaged with bells other than that specifically described, in order to form the braking band of a generic disk-brake disk.

Moreover, the bell may have differently shaped openings between the braces of the bell, for reducing weight. The shape of the openings for reducing weight advantageously permits the formation of a central ring suitable for the connection of the bell to a wheel hub of different diameter (Figures 11 to 12f).

Naturally, these and any further modifications and

variations applied to the present invention by a person skilled in the art should be considered to be included within the scope of protection as defined by the appended claims.

CLAIMS

1. Connection system between a bell (60) and a braking band (20) of a disk-brake disk, in which

the bell (60) comprises a plurality of connection elements, and

the band (20) comprises complementary connection elements, each provided with a seat,

the connection system being characterized in that:

the connection elements of the bell (60) are eyes (70) each having at least one through-hole (70'),

the complementary connection elements of the band (20) are axially superimposed and spaced-apart protuberances (38) each having at least one housing seat (44),

in the assembled configuration of the band (20) and of the bell (60), the protuberances (38) are arranged astride respective eyes (70) with the through-hole (70') and the housing seat (44) of each protuberance (38) aligned, and

the bell (60) is operatively connected to the band (20) by means of a connection element which can be inserted in the through-hole of the eye and at the same time can engage the braking band (20), extending through the seats, which allow the braking band (20) to slide substantially radially on the connection element.

2. Connection system according to Claim 1 in which the housing seats (44) are partially open towards the centre of the braking band (20).

3. Connection system according to Claim 1 or Claim 2 in which the protuberances (38) have, at their ends facing the centre of the braking band (20), prongs (40, 42) which at least partially define the housing seats (44).

4. Connection system according to Claim 3 in which the prongs (40, 42) have opposed working sides (40', 42') which engage the element for connection between the bell (60) and the braking band (20), achieving a rotational restraint between the band (20) and the bell (60).

5. Connection system according to Claim 4 in which each of the opposed sides (40', 42') of the prongs (40, 42) has a straight portion (40''', 42''').

6. Connection system according to Claim 5 in which the straight portions (40''', 42''') are parallel to a radial central axis (R-R) of the protuberance (38).

7. Connection system according to any one of the preceding claims in which the connection element engages a substantially flat working surface of the protuberance (38), parallel to a central radial axis (R-R) of the protuberance (38).

8. Connection system according to any one of the

preceding claims in which the connection element is a bush (82).

9. Connection system according to Claim 8 in which the connection system further comprises a resilient element (90) which can be fitted on the bush (82).

10. Connection system according to Claim 9 in which the connection system has a retaining ring (94) restrained on the bush (82) so as to preload the resilient element (90) against the braking band (20) and end portions (68') of braces (68) of the bell (60).

11. Connection system according to any one of the preceding claims in which the eyes (70) of the bell (60) are disposed in the region of end portions of braces (68) of an annular peripheral portion (62) of the bell (60).

12. Connection system according to any one of the preceding claims in which the eyes (70) are disposed in the region of respective outer end portions of spokes (66) connecting an annular peripheral portion (62) of the bell (60) to a central ring (64) of the bell (60).

13. Connection system according to Claim 11 or Claim 12 in which the eyes (70) are disposed in a portion in which braces (68) of the annular peripheral portion (62) of the bell are joined to spokes (66) connecting the annular peripheral portion (62) of the bell to the central ring (64) of the bell.

14. Connection system according to any one of the preceding claims in which the braking band (20) comprises a plate (22), the plate comprising:

a ring (26) having a defined axis (Y-Y), a braking surface or outer surface (22'') for cooperating with a caliper in order to exert a braking force, and an inner surface (22') opposite the outer surface (22'') and comprising spacer elements (32) arranged to coincide with similar spacer elements of a second plate (24) in order to form ventilation ducts of the braking band (20) of the self-ventilating disk (1).

15. Connection system according to Claim 14 in which the plate is characterized in that it further comprises:

a plurality of protuberances (38) projecting from the portion of the ring (26) facing the axis (Y-Y) and formed integrally therewith,

in which each protuberance has at least one housing seat (44) delimited by opposed sides (40', 42') defining thrust surfaces parallel to a central radial axis (R-R) of the protuberance (38), and

in which each housing seat (44) is suitable for cooperating with restraining means of the bell (60) of the disk (1), the restraining means being suitable for permitting expansion or contraction of the braking band (20).

16. Connection system according to Claim 15 in which the housing seats (44) are partially open.

17. Connection system according to Claim 15 or Claim 16 in which the housing seats (44) are partially open towards the centre of the braking band (20).

18. Connection system according to any one of Claims 15 to 17 in which the protuberances (38) have, at their ends facing the centre of the braking band (20), prongs (40, 42) which at least partially define the housing seats (44).

19. Connection system according to Claim 18 in which the prongs (40, 42) comprise the opposed sides (40', 42') which engage the restraining means of the bell (60).

20. Connection system according to any one of Claims 15 to 19 in which there are six protuberances.

21. Connection system according to any one of Claims 15 to 19 in which the protuberances are spaced apart equiangularly.

22. Connection system according to any one of Claims 15 to 21 in which the outer surface (22'') of the plate has recesses (30).

23. Connection system according to Claim 22 in which each of the recesses (30) corresponds to a spacer element (32) on the inner surface (22').

24. Plate (22) of a braking band (20) of a self-

ventilating disk-brake disk (1), comprising:

a ring (26) having a defined axis (Y-Y), a braking surface or outer surface (22'') for cooperating with a caliper in order to exert a braking force, and an inner surface (22') opposite the outer surface (22'') and comprising spacer elements (32) arranged to coincide with similar spacer elements of a second plate (24) in order to form ventilation ducts of the braking band (20) of the self-ventilating disk (1),

the plate being characterized in that it further comprises:

a plurality of protuberances (38) projecting from the portion of the ring (26) facing the axis (Y-Y) and formed integrally therewith,

in which each protuberance has at least one housing seat (44) delimited by opposed sides (40', 42') defining thrust surfaces parallel to a central radial axis (R-R) of the protuberance (38), and

in which each housing seat (44) is suitable for cooperating with restraining means of the bell (60) of the disk (1), the restraining means being suitable for permitting expansion or contraction of the braking band (20).

25. Plate according to Claim 24 in which the housing seats (44) are partially open.

26. Plate according to Claim 25 or Claim 26 in which the housing seats (44) are partially open towards the centre of the braking band (20).

27. Plate according to any one of Claims 24 to 26 in which the protuberances (38) have, at their ends facing the centre of the braking band (20), prongs (40, 42) which at least partially define the housing seats (44).

28. Plate according to Claim 27 in which the prongs (40, 42) comprise the opposed sides (40', 42') which engage the restraining means of the bell (60).

29. Plate according to any one of Claims 24 to 28 in which there are six protuberances.

30. Plate according to any one of Claims 24 to 29 in which the protuberances are spaced apart equiangularly.

31. Plate according to any one of Claims 24 to 30 in which the outer surface (22'') of the plate has recesses (30).

32. Plate according to Claim 31 in which each of the recesses (30) corresponds to a spacer element (32) on the inner surface (22').

33. Braking band (20) of a self-ventilating disk-brake disk comprising at least two plates (22, 24) according to any one of Claims 24 to 32.

34. Braking band according to Claim 33 in which the plates are fixed together firmly in the region of the

respective inner surfaces (22', 24') by a welding process.

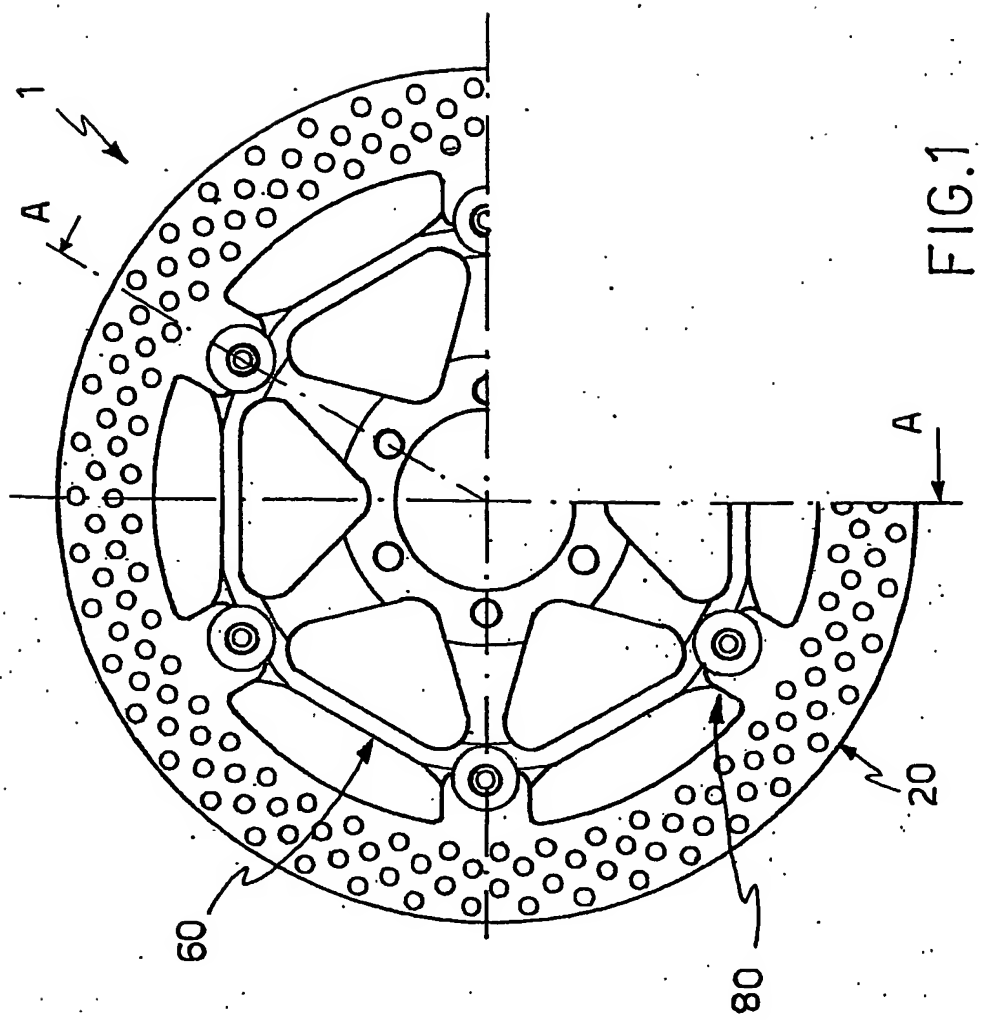


FIG.1

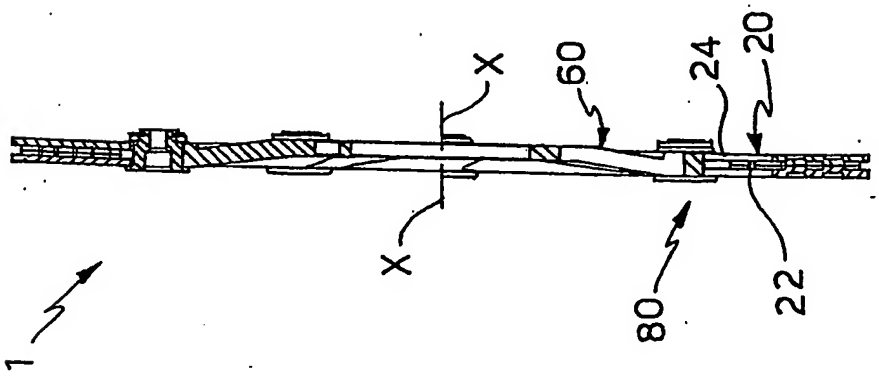


FIG.2

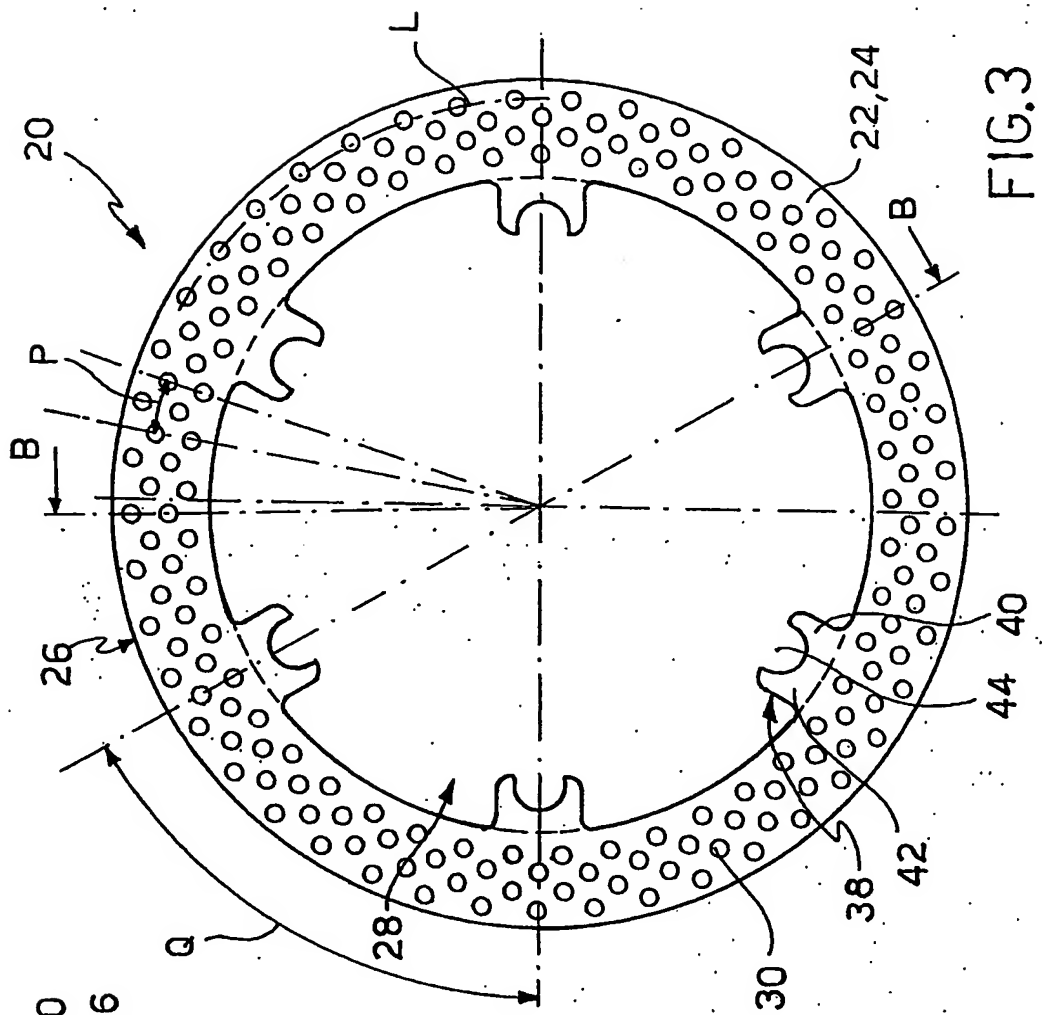

L
20
22,24
B
P
B
26
40
44
42
38
28
30
Q

FIG.3

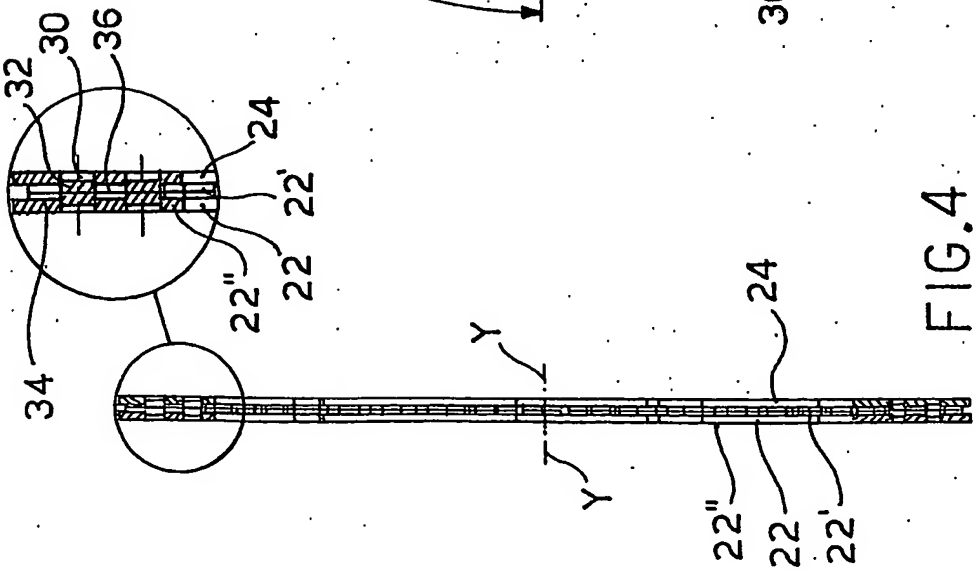

32
30
36
24
22'
22"
22
34
Y
24
Y
22"
22
22'

FIG.4

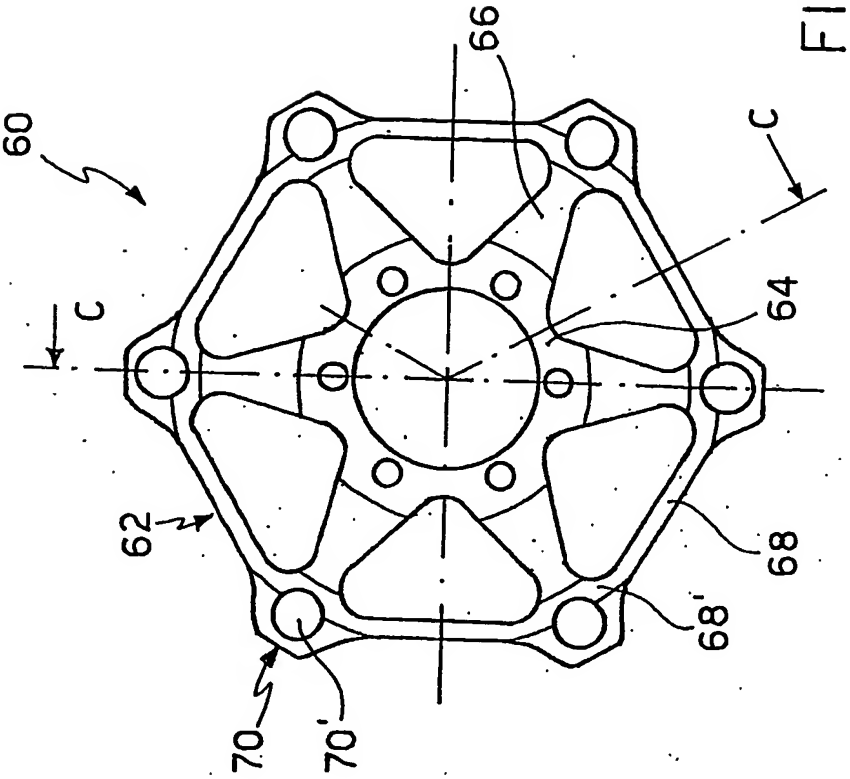


FIG.5

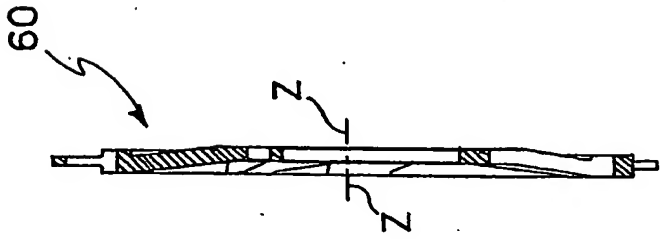


FIG.6

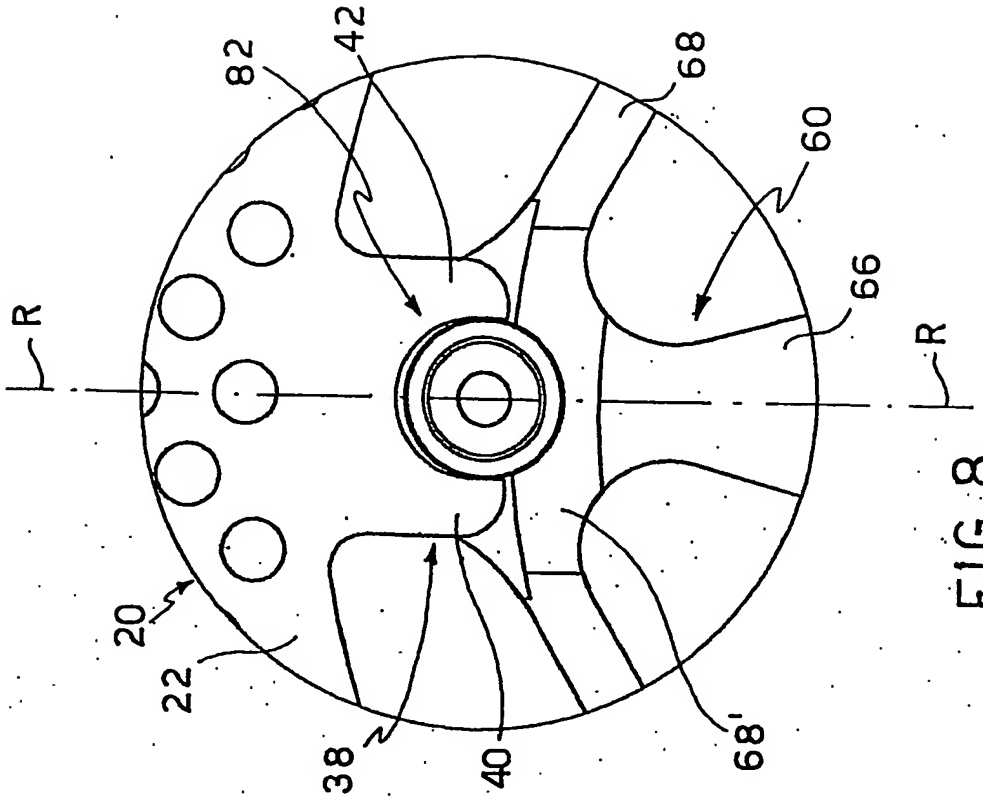


FIG. 8

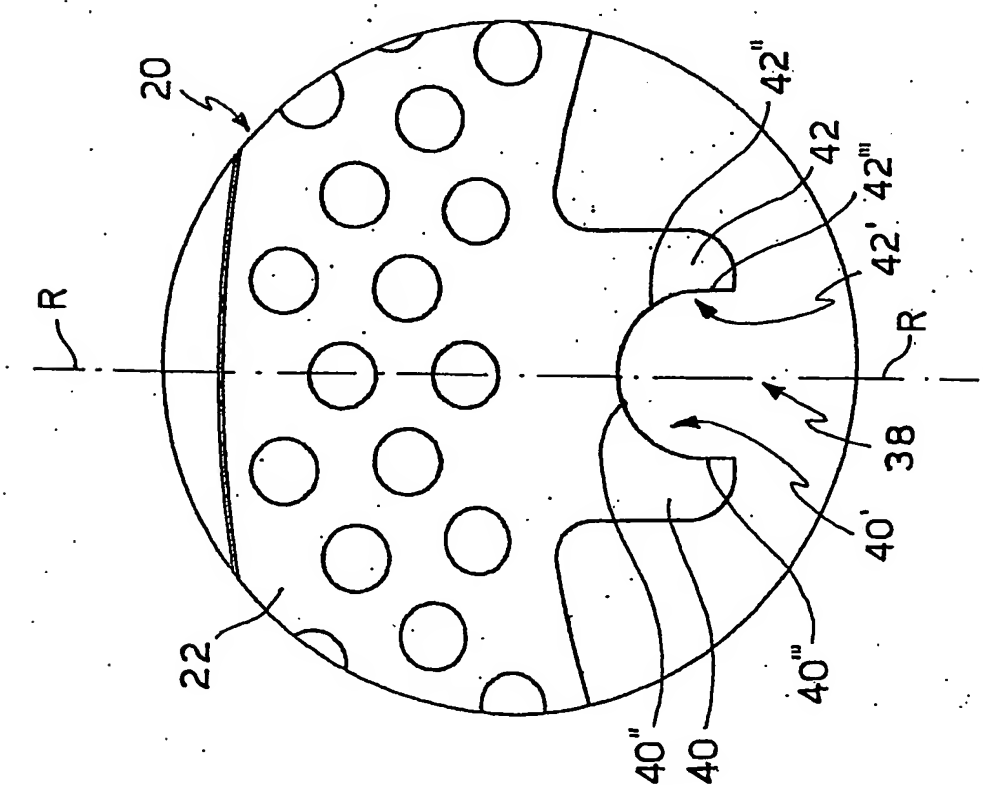


FIG. 7

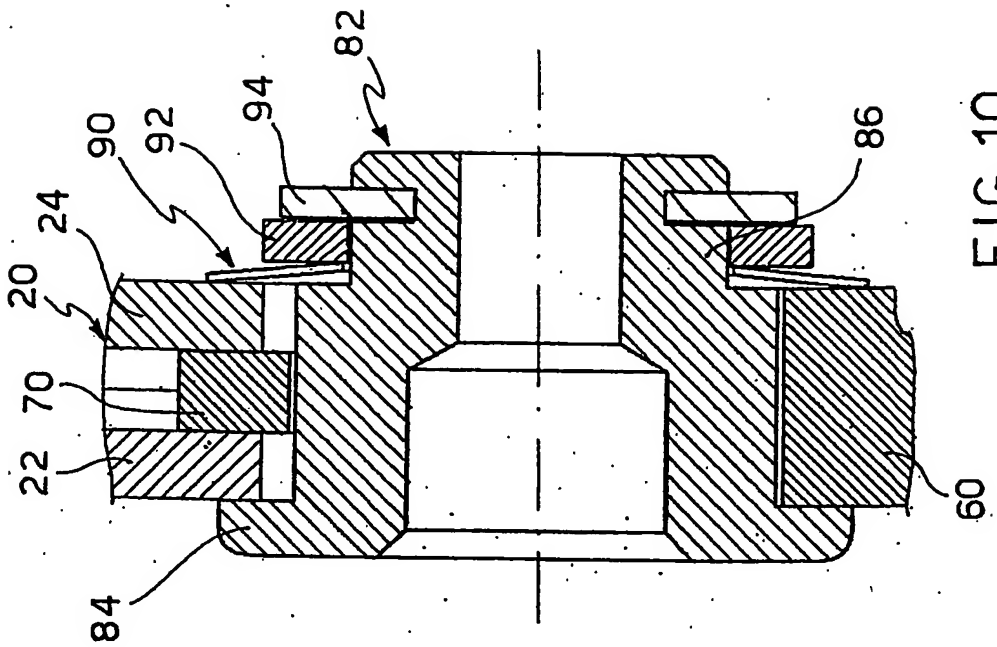


FIG.10

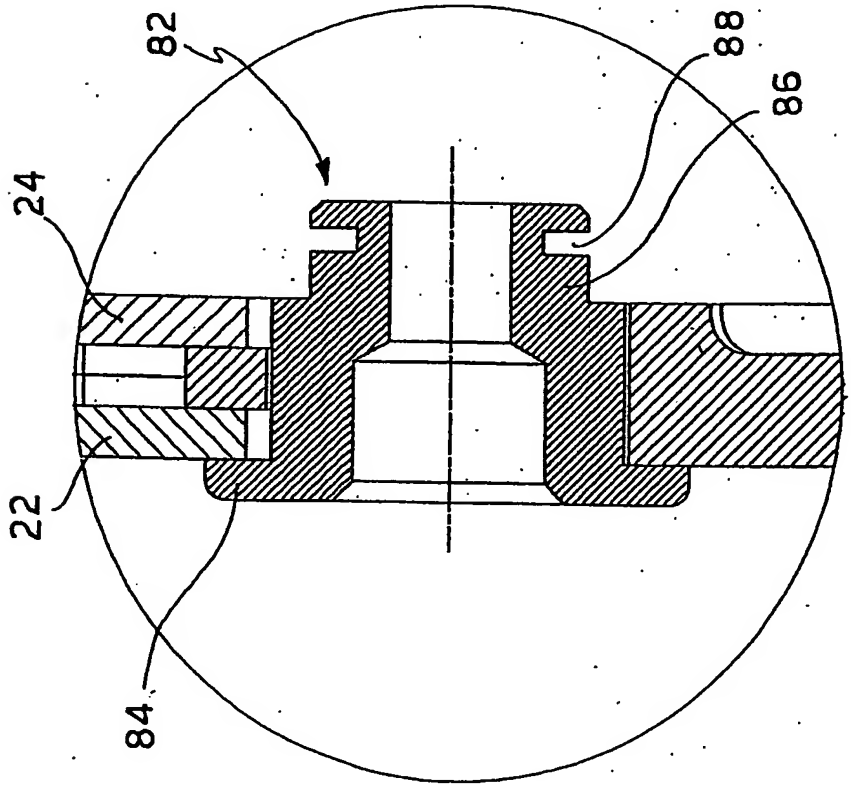


FIG.9

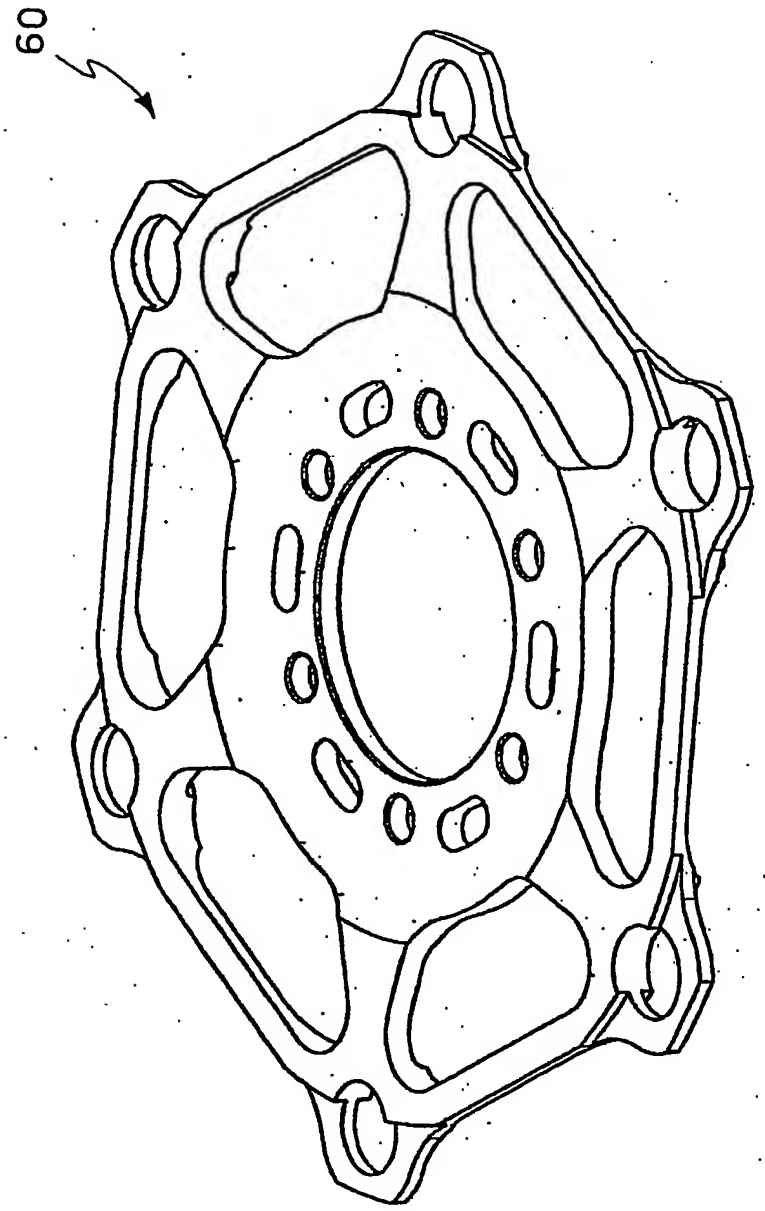
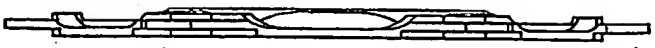


FIG.11

FIG.12d



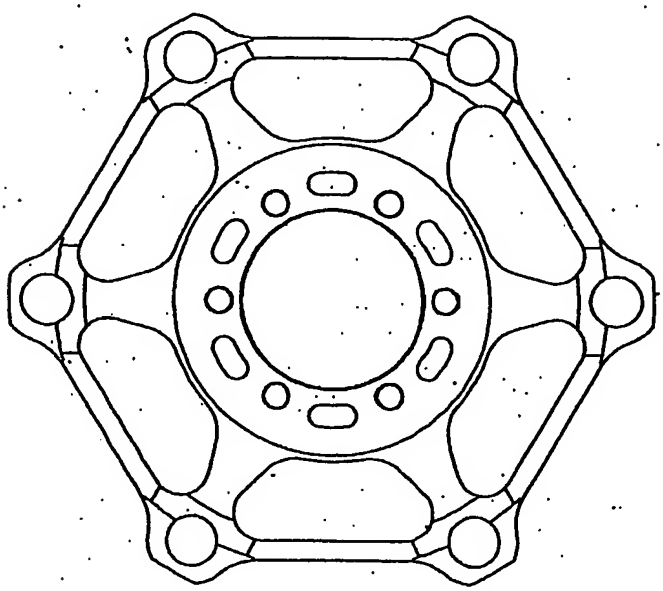


FIG.12e FIG.12a FIG.12c

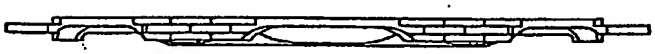


FIG.12b

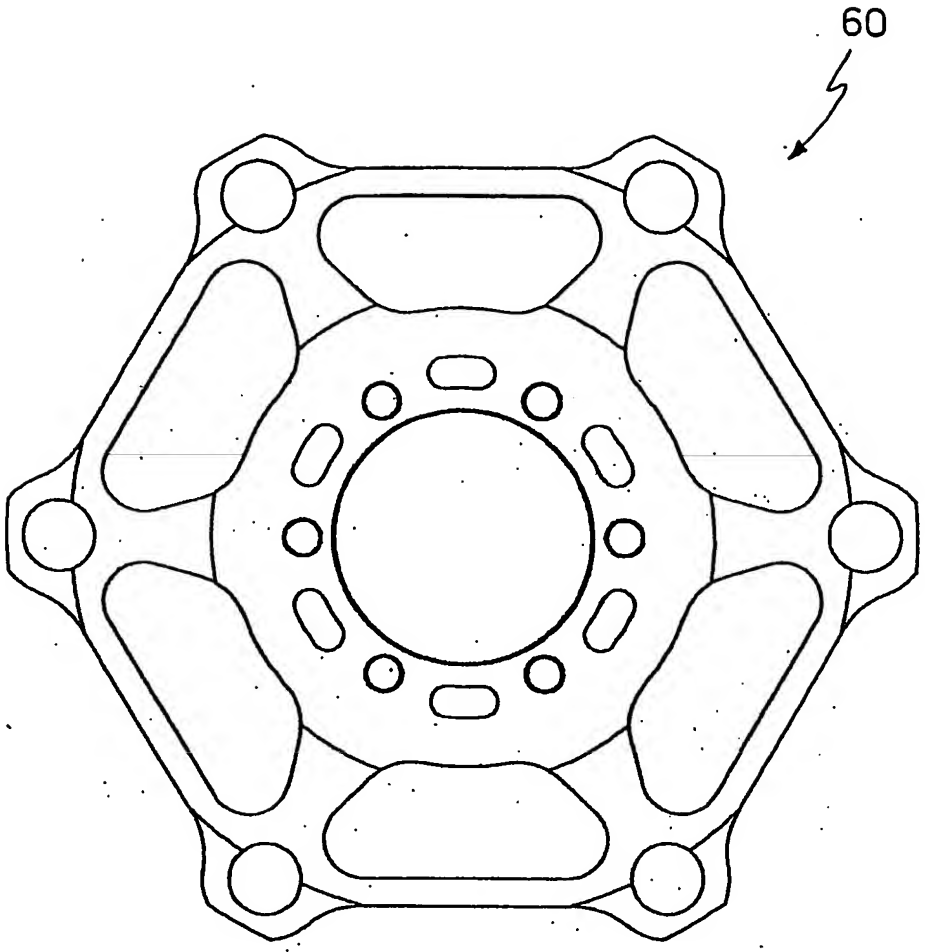


FIG. 12f

INTERNATIONAL SEARCH REPORT

International Application No
PCT/IT 02/00048

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 F16D65/12

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 F16D

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
EPO-Internal, WPI Data, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP 0 085 361 A (INNOCENTE RIGANTI OFF MEC) 10 August 1983 (1983-08-10) the whole document	1-7,11, 14-19, 21, 24-28, 30,33
X	US 6 139 215 A (BIEKER DIETER ET AL) 31 October 2000 (2000-10-31) the whole document	1-8,11, 14-19, 21, 24-28,30
A	EP 0 994 269 A (SHIMANO KK) 19 April 2000 (2000-04-19) column 6, line 8 - line 47; figures 5-9	1,7-15, 21,22, 24,30,31

-/—

[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

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"O" document referring to an oral disclosure, use, exhibition or other means

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"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
30 August 2002	10/09/2002

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL – 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax (+31-70) 340-3016	Gertig, I

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INTERNATIONAL SEARCH REPORT

International Application No
PCT/IT 02/00048

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 4 448 291 A (JOHANNESEN DONALD D ET AL) 15 May 1984 (1984-05-15) cited in the application column 2, line 48 - line 65; figures 5,6	22,23, 31,32

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No
PCT/IT 02/00048

Patent document cited in search report		Publication date	Patent family member(s)		Publication date
EP 0085361	A	10-08-1983	IT	1200365 B	18-01-1989
			AT	31350 T	15-12-1987
			DE	3374893 D1	21-01-1988
			EP	0085361 A1	10-08-1983
US 6139215	A	31-10-2000	DE	19544559 C1	03-07-1997
			AU	7570096 A	19-06-1997
			BR	9611828 A	13-07-1999
			DE	59607279 D1	16-08-2001
			WO	9720151 A1	05-06-1997
			EP	0864053 A1	16-09-1998
			JP	2000501158 T	02-02-2000
EP 0994269	A	19-04-2000	US	6164421 A	26-12-2000
			CN	1251341 A	26-04-2000
			EP	0994269 A2	19-04-2000
			JP	2000120732 A	25-04-2000
			TW	453964 B	11-09-2001
US 4448291	A	15-05-1984	AR	228547 A1	15-03-1983
			DE	3277072 D1	01-10-1987
			EP	0082786 A1	29-06-1983
			MX	154616 A	30-10-1987